

WISCONSIN DEPARTMENT OF NATURAL RESOURCES

NORTHWEST DISTRICT

**FISH MANAGEMENT BUREAU
Management Report Number 65**

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PROGRESS REPORT

**Lake Trout Homing, Migration and
Mortality Studies, Lake Superior**

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LAKE TROUT HOMING, MIGRATION AND MORTALITY

Introduction

Since October 1963, both hatchery origin and native lake trout have been tagged by the Department of Natural Resources and the Bureau of Sport Fisheries and Wildlife in the Apostle Islands region of Lake Superior. The following progress report, conclusive to June 7th, 1973, is based on data obtained from tagged fish returns.

Three types of tags are employed in the program: dart (Floy) tags, used by the Department of Natural Resources from 1969 to the present (inserted below the posterior end of the dorsal fin); the chicken band, used by the Bureau of Sport Fisheries and Wildlife (coiled around the mandible); and monel jaw tags, used by both agencies during the initial years. In computing the percent-tag returns, multiple recaptures were considered new recoveries. Because of the numerous instances in which the recapture size is not available, the size at tagging is used on the accompanying tag recapture maps. To allow for adequate distribution of tagged fish, lake trout recaptured prior to initial ice-out following tagging are not included in this report.

Homing

Various studies have indicated that lake trout home to their native reefs (Eschmeyer, 1955 and Rahrer, 1968). Hopefully, this study will add to available evidence that homing does occur, at least in the case of native fish. As illustrated in Table 1, 98.6% of the October native recaptures occurred at the reef in which the native lake trout were tagged (283 out of 287 recaptures 1963-72). A minor source of error in this conclusion is that native lake trout captured on a spawning reef may have been in route to another reef and not to the reef of capture. Sampling dates have remained reasonably consistent over the years.

Hatchery reared lake trout spawning on Gull Island Shoals only achieved a 58.6% return (17 out of 29 recaptures). Hatchery fish for all locations homed only *60.1% of the time with a high of 81.4% at Sand Cut Reef (56 out of 68 recaptures), and a low of 47.1% at Cat Island Shoal (8 out of 17 recaptures). This apparent wandering by hatchery-origin lake trout, in comparison to native lake trout, may greatly reduce their spawning potential. Most natives return to the same reef to spawn (likely the reef of their origin), insuring a continuance of mature spawning fish

* Means not weighted.

HATCHERY-ORIGIN

NATIVES

Spawning Site	Total Tagged	% Recap	% Recaps Homing	Other Sampling Sites Frequented	Total Tagged	% Recap	% Recaps Homing	Other Sampling Sites Frequented
Gull Island Shoals	630	4.6%	58.6%	CIS - 3 KEW - 3 SCR - 5 VTP - 1	1032*	8.62%*	98.6%	SCR* - 1 CIS - 3
Cat Island Shoals	310	5.48%	47.1%	2 mi. SW Big Bay Pt. - 1 Gull Is. - 6 Stockton Is. - 1 NE Outer Is. - 1	428	9.35%	97.5%	GIS - 1
Sand Cut Reef	805	8.45%	81.4%	VTP - 4 Sand Bay - 1 KEW - 1 Squaw Pt. - 1 CIS - 1 GIS - 2 E. Basswood - 1 Bad R. Reef - 1	206	13.1%	100%	
Van Tassell's Point	1099	1.27%	57.1%	SCR - 4 GIS - 1 Michigan Is. - 1	NO NATIVES			
	2844	4.95%	60.1%		1666	10.35%	98.1%	

CIS - Cat Island Shoal
 SCR - Sand Cut Reef
 VTP - Van Tassell's Point
 GIS - Gull Island Shoals
 KEW - Keweenaw Peninsula Vicinity

* Data included 1969-72 only. Percent recaps homing includes fish captured in federal studies from 1963-72

and continued selection and use of an appropriate hatching and rearing site. The hatchery fish appear non-distinctive in site selection and thereby unable to fulfill many of the needed and anticipated requirements for successful propagation. The largest runs of hatchery fish have been in inshore areas not known as major spawning grounds. Most return to areas where they were planted or to similar shore areas, and some to traditional spawning grounds. Some of these areas are merely shallow sand beaches that appear to be highly unsuitable for incubation of eggs overwinter (Pycha, 1972). Hatchery-origin lake trout may also demonstrate a progressive decrease in the annual spawning sequence for a specific reef, regressing from 100% (fish initially spawned on a specific reef) to 60% (homing return percentage after one year) to 36% the following year, 21.6% the following year, and so on. The wandering phenomenon is also apparent in the total percent return of tagged trout to any sampled reef in October. Hatchery lake trout averaged *4.95% return of tagged fish, with a high of 8.45% (68 recaptured out of 805) at Sand Cut Reef and a low of 1.27% (14 recaptured out of 1099) at Van Tassell's Point. Native lake trout averaged *10.36%, with a high of 13.1% (27 recaptured out of 206) at Sand Cut Reef and a low of 8.62% (89 recaptured out of 1032) at Gull Island Shoals. Population sizes of the specific reef would greatly influence the percent return of all tags in October. Relative abundance indicates that Gull Island Shoals' native spawning population is considerably larger than any of the hatchery populations on other reefs in this report; yet the total percent returned is still higher than that of any of the hatchery spawning groups.

Migration Patterns

Due to the small number of tag returns from native (157) and hatchery (128) fish, natives from all study reefs will be combined to study their movements, as with the hatchery fish. Variations in fishing intensity and sampling may bias and disfigure the actual distribution of both native and hatchery origin lake trout.

Rahrer (1968) reported that most returns of spawning lake trout from Gull Island Shoals (included in this report) were from the Apostle Islands region, west of Gull Island Shoals. Recoveries made in August and September indicated that lake trout were moving back to their spawning reefs. Tag returns from natives in this report indicate that many remain in the Apostle Islands region, however, a large proportion (32.3%) move eastward into the Michigan waters of Lake Superior and, as Rahrer concluded, return towards their spawning reef in August and September. (Appendices I through VI). Many of the larger fish appear to migrate to areas on the fringe of the Apostle Islands which are less accessible to the sport fishery, however, the separation between large and small natives is in no way distinct.

Hatchery trout display a pattern similar to that of natives except they tend to remain in the areas more accessible to the sport fishery and also close to the areas of stocking. (Appendices VII through XII). A significant proportion leave Wisconsin waters in the late spring and

* Means not weighted.

summer and move eastward into Michigan waters along both sides of the Keweenaw Peninsula (38.2%).

Eschmeyer, Daly, and Erkkila (1952) performed a similar study. (prior to the lamprey onslaught) to determine migration patterns of lake trout. Most of their tagged trout remained in Wisconsin waters (76.4%), however 14.3% of their returns came from Minnesota and only 9.3% from Michigan waters. A possible cause for the discrepancy in migration patterns of the two studies are the prevailing currents. The trout tagged in the western portion of the Apostle Islands by Eschmeyer, et al, were caught in a counter-clockwise eddy which exists in the western end of the lake; whereas tagged trout in the Eastern Apostle Islands tend to move with the easterly flowing current along the south shore (Figure 1).

At present, a stocking program is underway in which yearling lake trout are being stocked on Devil's Island Reef (historically a major lake trout spawning ground) in the hope of establishing another major spawning ground similar to Gull Island Shoals. If successful, it may also enhance the fishing in the most western portion of the lake.

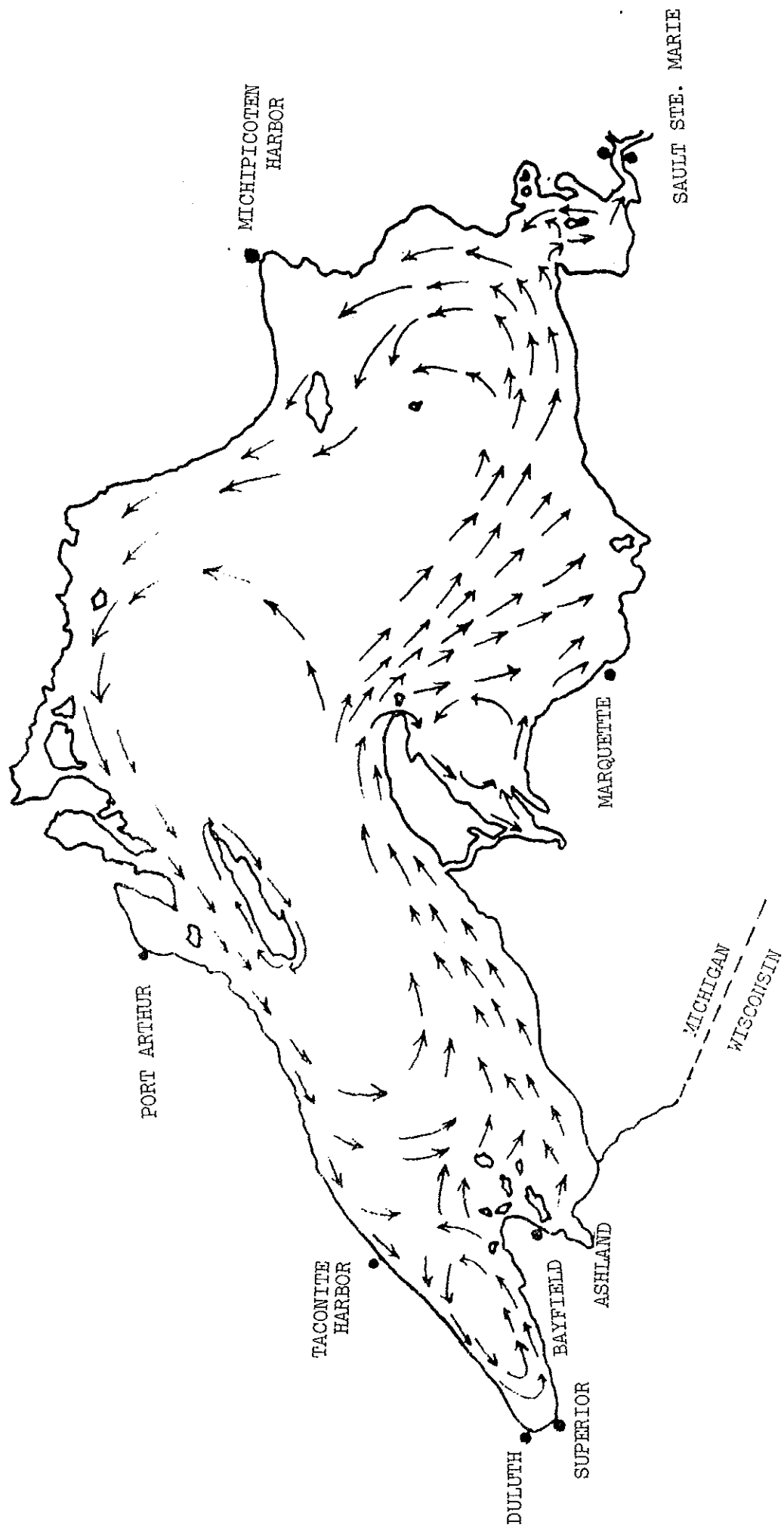
Population Estimates for Gull Island Shoals

Population estimates of spawning lake trout on Gull Island Shoals were attempted for the years 1963-1971; Table 2. Gull Island Shoals has the distinction of being the first area in the Great Lakes to re-establish a self-sustaining lake trout population since the sea lamprey has been held in check. It was deemed informative to determine the approximate population size required for reestablishing the lake trout in past spawning reefs. Although Gull Island Shoals is different from other lake trout spawning reefs in that it never completely lost its native population, abundance declined throughout the 1950's to an all-time low in 1961 when no females and only a few males were taken in the assessment nets. After the reduction of sea lampreys and the closure of the fisheries in 1961 and 1962, abundance increased rapidly. By the fall of 1964, abundance of females was higher than in any previous year of assessment fishing (Pycha, 1972).

The spawning population was divided into three size groups: 24.9" and smaller; 25.0" through 28.9"; and 29.0" and greater. Size division was necessary because of the differences in total mortality rates of lake trout as they grow, mainly due to fishing mortality, natural mortality, and lamprey selectivity. Total mortality rates for the various size groups were obtained from relative abundance figures for consecutive years on Gull Island Shoals (Table 3).

Various assumptions were made to obtain a population estimate of which consecutive annual spawning after initial spawning is most important. Rawson (1947) believed that lake trout spawned once in two years in Great Slave Lake, and once in three years in Great Bear Lake. In Lake La Rouge, Saskatchewan, about 8% of the mature females don't spawn in a given year. In Watertown Lake, Alberta, Cuerrier and Schultz (1957)

Figure 1. Prevailing Currents of Lake Superior



GULL ISLAND SHOALS SPAWNING POPULATION ESTIMATES
COMPARED TO RELATIVE ABUNDANCE ESTIMATES

YEAR OF POP. EST.	21"-24.9"	25"-28.9"	29.0" and up	TOTAL	C.P.E./1,000
** 1963	(0) -----	(4) 2214.0	(0) -----	2214.0	3.92
** 1964	(5) 2956.9	(13) 2747.5	(2) 651.1	6355.1	35.4
** 1965	(3) 2440.9	(17) 1372.4	(4) 619.3	4432.6	38.2
** 1966	(2) 1810.7	(2) 8957.3	(1) 3794.0	14,562.0	19.8
** 1967	(4) 1071.0	(11) 1093.4	(1) 1156.8	3321.2	20.8
** 1968	(1) 1404.7	(6) 852.7	(6) 475.5	2732.9	19.9
1969	(1) 2568.2	(4) 2252.6	(4) 620.3	5441.0	16.3
1970	(7) 3695.2	(5) 4212.4	(4) 433.8	8314.4	57.6
1971	(18) 3959.6	(16) 7073.9	(5) 544.1	11,577.6	55.6

** Population Estimate based on Bureau of Sport Fisheries and Wildlife Tags

Tag Loss and Mortality at Tagging: 14.7% - Department of Natural Resources
5.0% - Bureau of Sport Fisheries and Wildlife

TABLE 3

Total Mortality Estimates for Gull Island Shoal Spawning Lake Trout.
Estimates Derived From Catch Per Unit of Effort Data For the Period
of 1963-1972*.

Spawning Age	(No. of Fish)	Total Mortality (%)
8	(1,119 - 1963-71)	32.5%
9	(755 - 1964-72)	
<hr/>		
9	(610 - 1963-71)	56.2%
10	(267 - 1964-72)	
<hr/>		
10	(257 - 1963-71)	75.0%
11	(64 - 1964-72)	
<hr/>		
11	(31 - 1963-71)	80.5%
12	(6 - 1964-72)	
		77.8%**

77.8%**

* 1969-70 C.P.E. figures not incorporated due to change of gear.

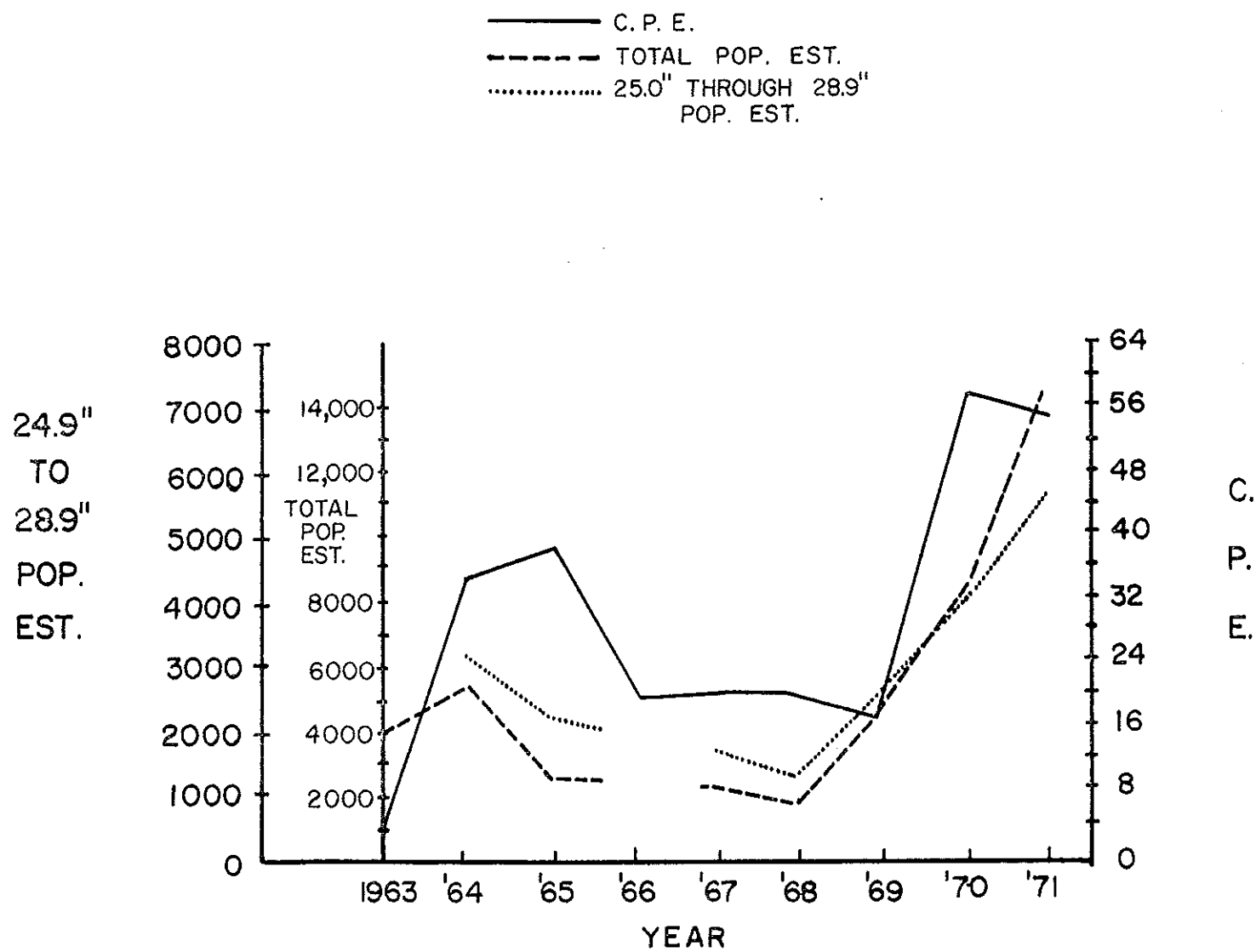
** Combined to give total mortality for spawners larger than 29 inches

thought lake trout spawned every other year, however, Royce in New York believed they spawn each year after maturity. Gull Island Shoals illustrated numerous tag returns one year after the tagging. The same is true for Cat Island Shoals and Sand Cut Reef. In 1971, 668 lake trout were tagged on Gull Island Shoals out of an estimated population of 11,577. In 1972, 38 of the tagged trout were recaptured on Gull Island Shoals, which is 11.6% of the estimated tagged lake trout surviving to spawn in 1972 (328). The large yield of tag returns for only three 24-hour gill net sets during the spawning season would indicate a large proportion are spawning annually. Additional evidence of consecutive spawning, given in Table 2 and Figure 2, shows the population estimate for the combined size groups and also for the 25.0" through 28.9" size class, in comparison with C.P.E. data obtained during annual spawning. The 24" and below and the 29" and greater size groups tag returns for most years are below the desired amount (7 or more), but the 25.0" through 28.9" size group is better represented and therefore gives a more accurate estimate of the population for comparisons with C.P.E. The 1966 estimate has been excluded because of the low number of tag returns (five). Comparison of the annual C.P.E. with the population estimates, demonstrates that both appear to follow similar trends. When using the 25.0" through 28.9" group estimates, the similarity is even more in accord. This indicates that if C.P.C. data is representative of yearly spawning population size on Gull Island Shoals, then the population estimates are also indicative of the population size; thereby indicating substantial consecutive annual spawning.

Summary

1. Native lake trout home nearly 100% to the same reef to spawn (probably their natal reef).
2. Hatchery-origin lake trout do not show distinctive homing to any known lake trout spawning ground, thus reducing their effectiveness to reestablish lake trout populations on reefs. At the present, lake trout yearling stocked on reefs show a tendency to return to those reefs.
3. Nearly one third of all lake trout tagged on Wisconsin spawning grounds, both hatchery (38.2%) and native (32.3%), migrate into Michigan waters of Lake Superior in the summer. Natives return to Wisconsin to spawn whereas many of the hatchery fish may not return, at least to the sampled spawning reefs.
4. Preliminary indications are that the bulk of native lake trout spawn annually.
5. The Gull Island Shoal lake trout spawning population has nearly doubled in the past nine years.

Figure 2



Acknowledgements

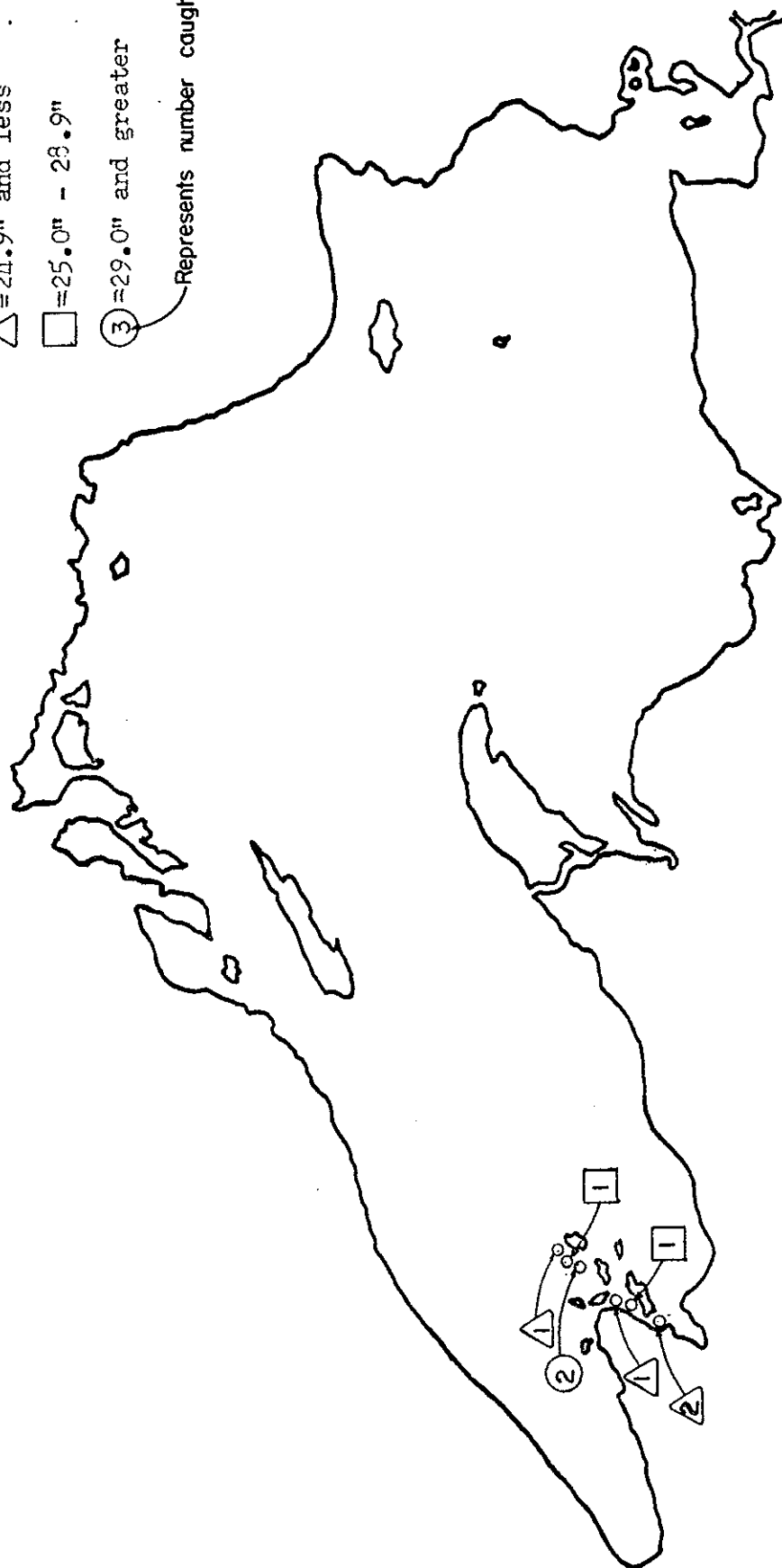
The efforts of Brian Beloyer, George King, the crew of the survey vessel " Noyes" and the Bureau of Sport Fisheries and Wildlife (Ashland Biological Station) are gratefully acknowledged.

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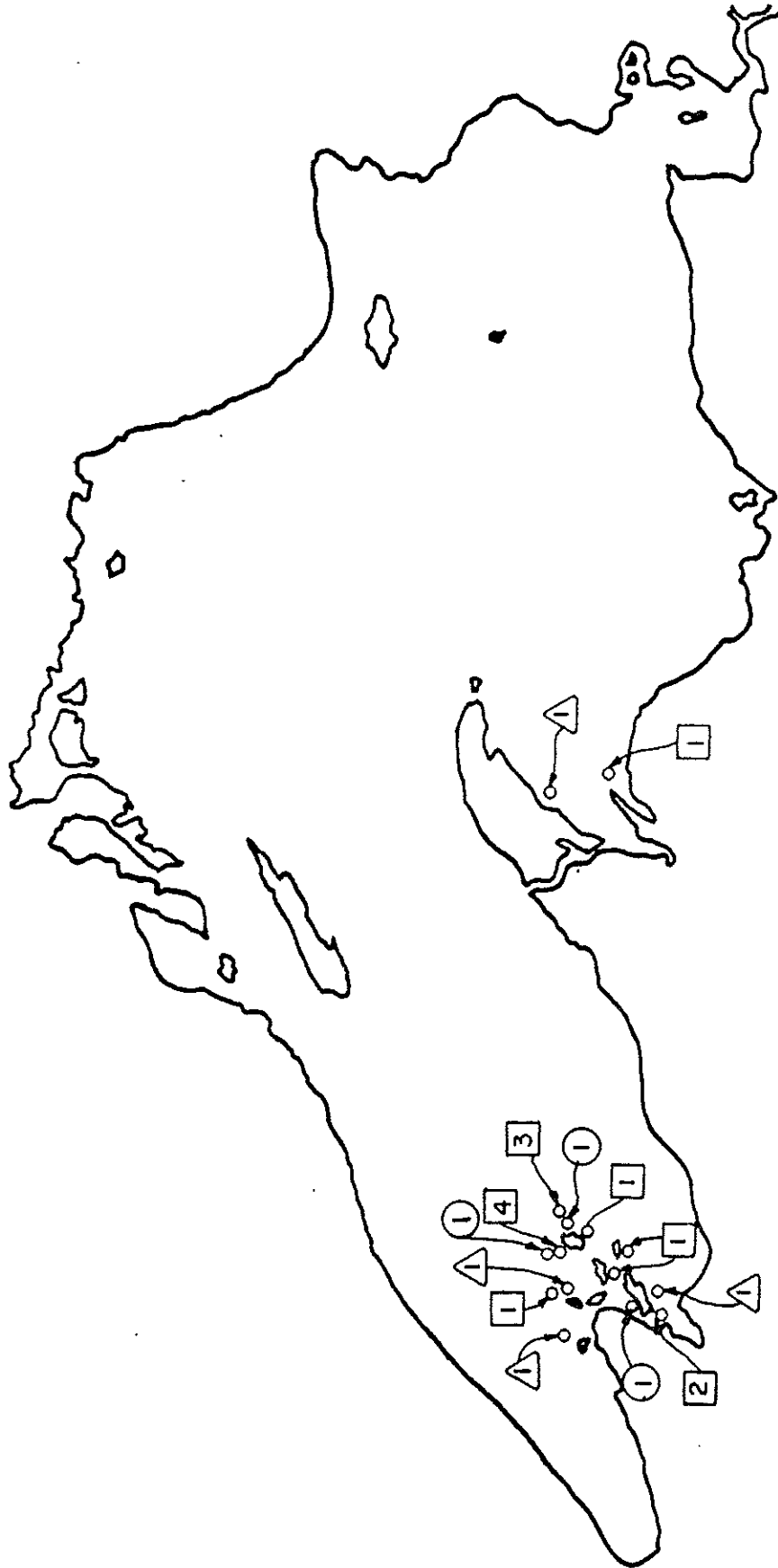
NATIVE LAKE TROUT TAG RETURNS

- △ = 24.9" and less
 - = 25.0" - 28.9"
 - ③ = 29.0" and greater
- Represents number caught



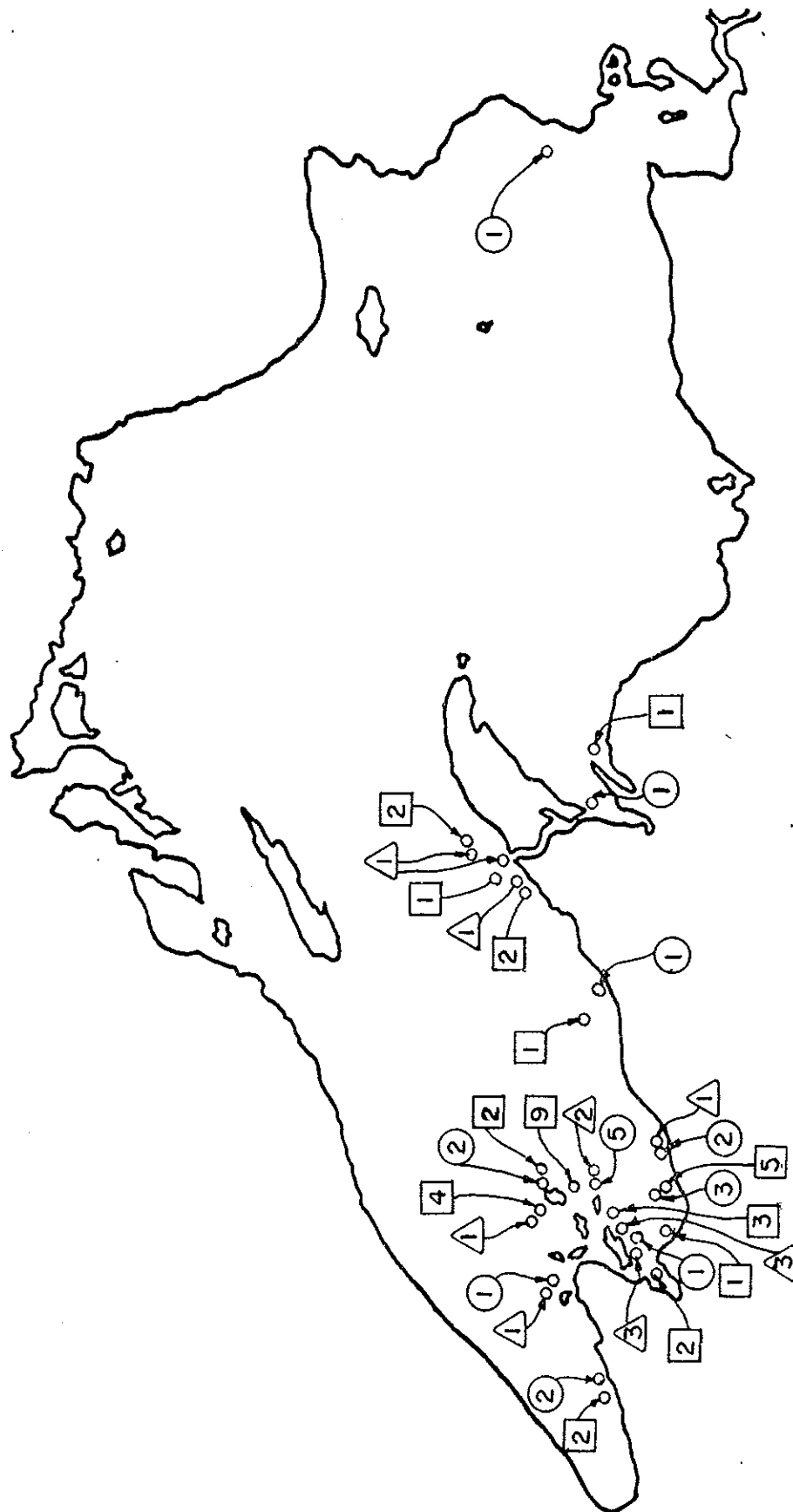
JANUARY - FEBRUARY

NATIVE LAKE TROUT TAG RETURNS



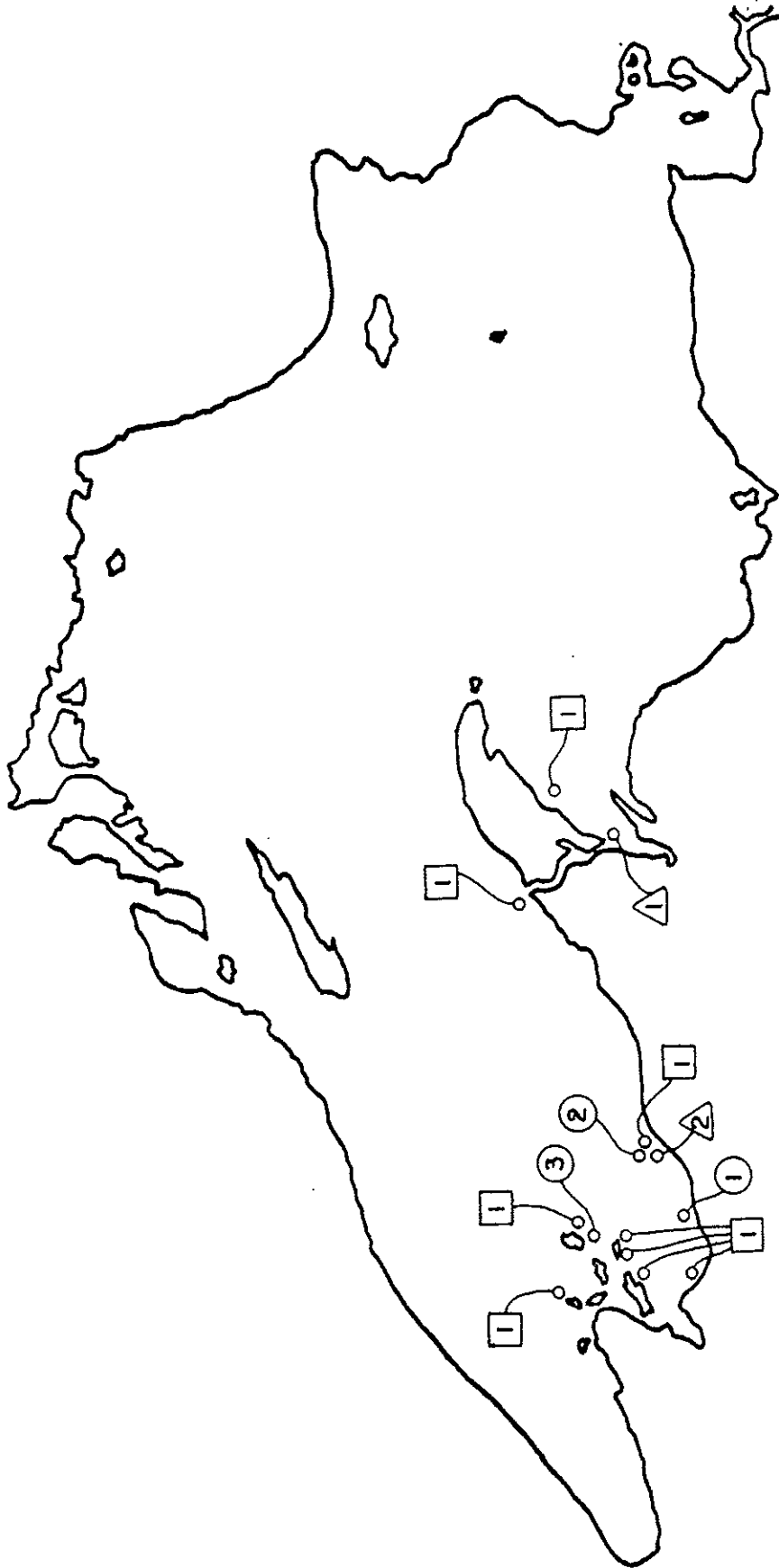
MARCH - APRIL

NATIVE LAKE TROUT TAG RETURNS



MAY - JUNE - JULY

AUGUST - SEPTEMBER



Appendix V

NATIVE LAKE TROUT TAG RETURNS



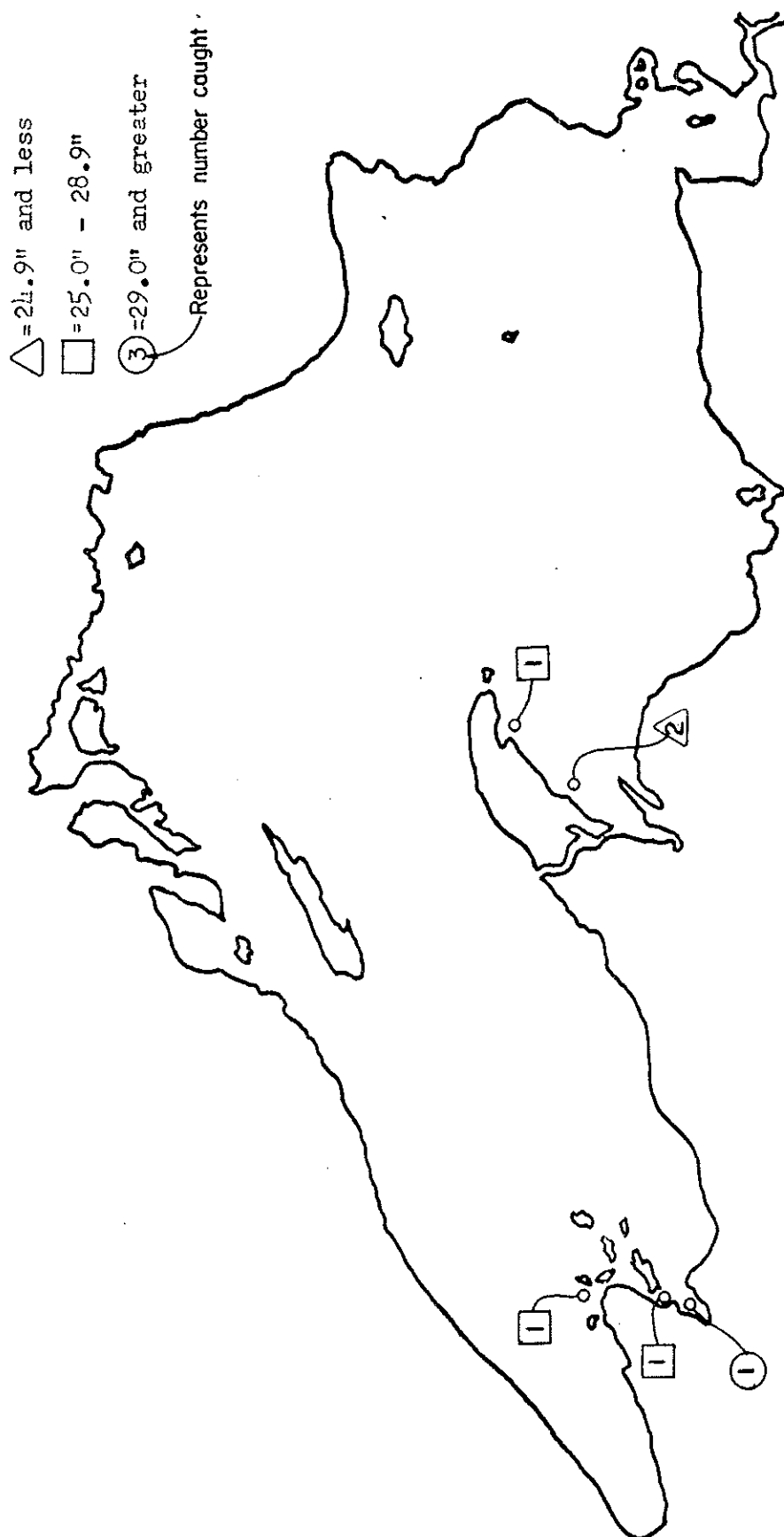
OCTOBER

NATIVE LAKE TROUT TAG RETURNS

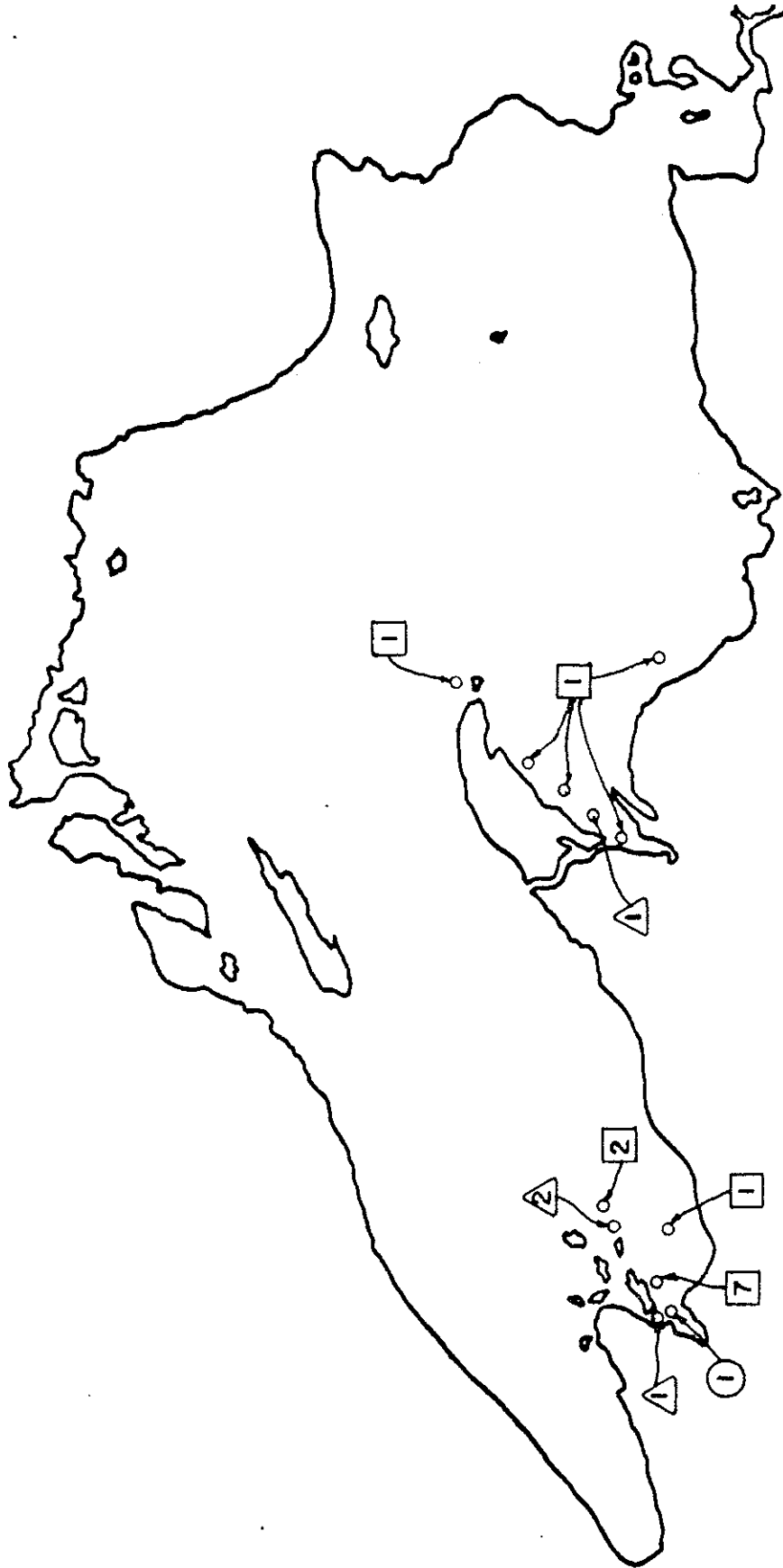


NOVEMBER - DECEMBER

JANUARY - FEBRUARY



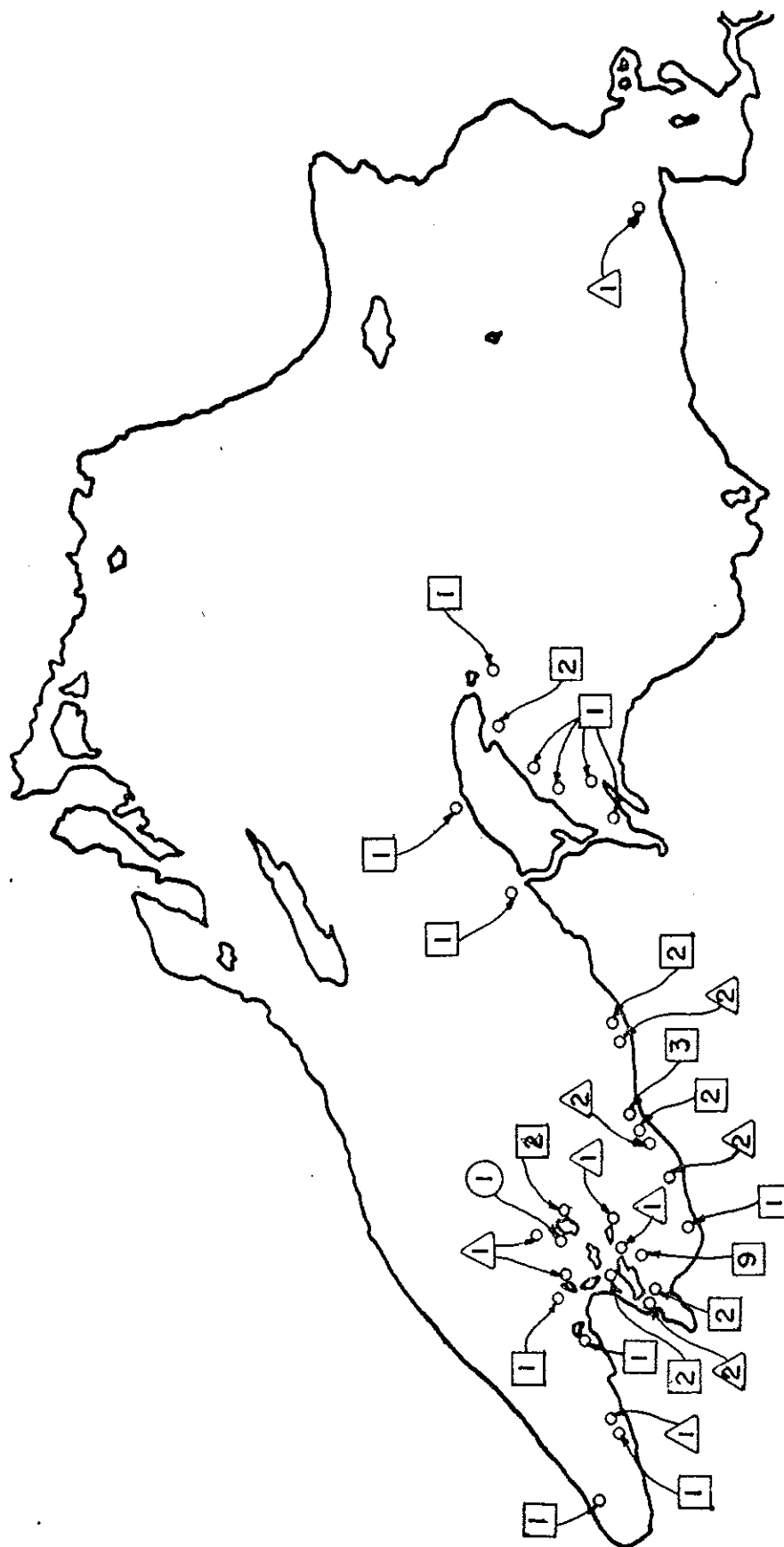
HATCHERY ORIGIN LAKE TROUT TAG RETURNS



MARCH - APRIL

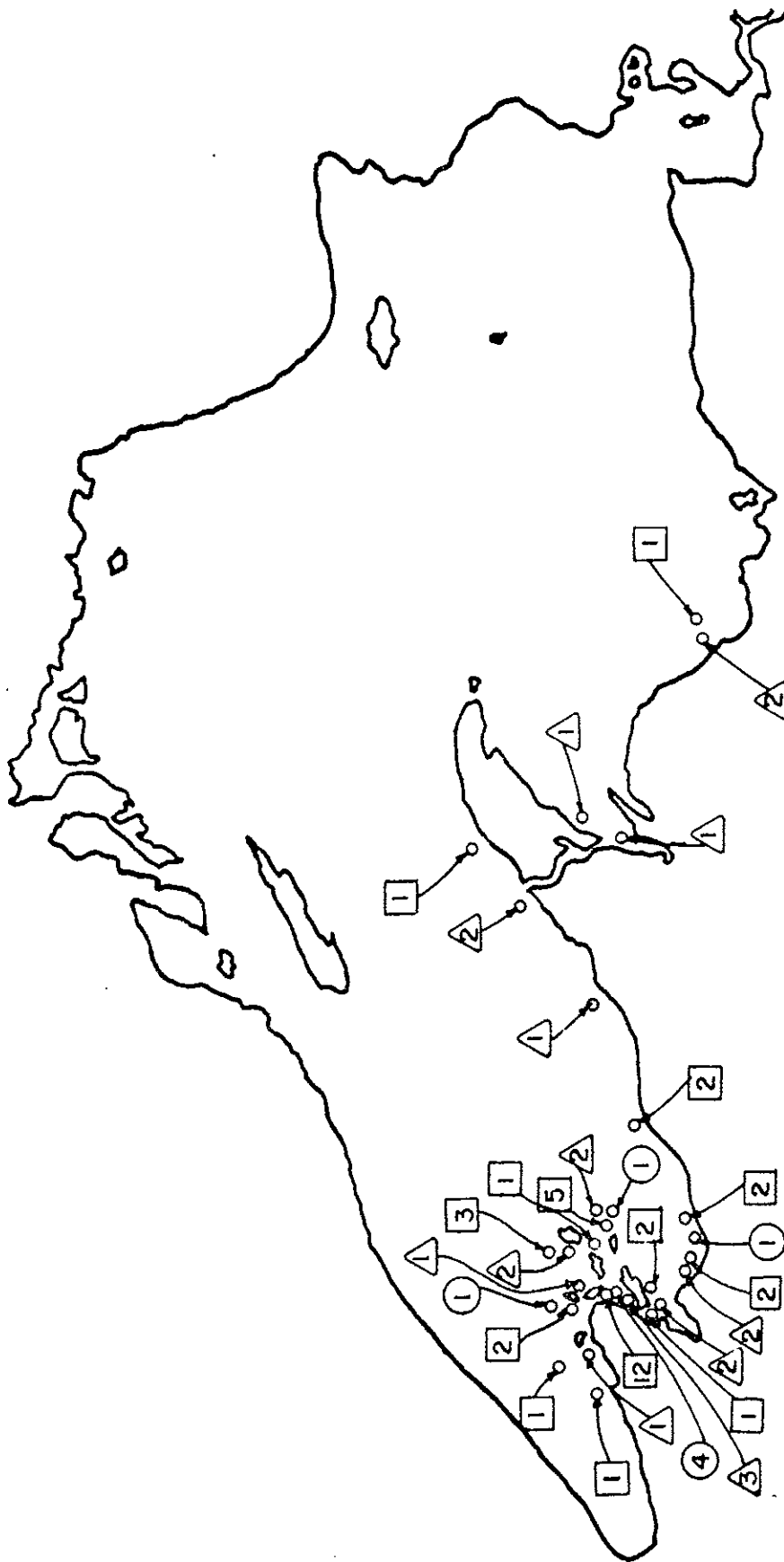
Appendix IX

HATCHERY ORIGIN LAKE TROUT TAG RETURNS



MAY - JUNE - JULY

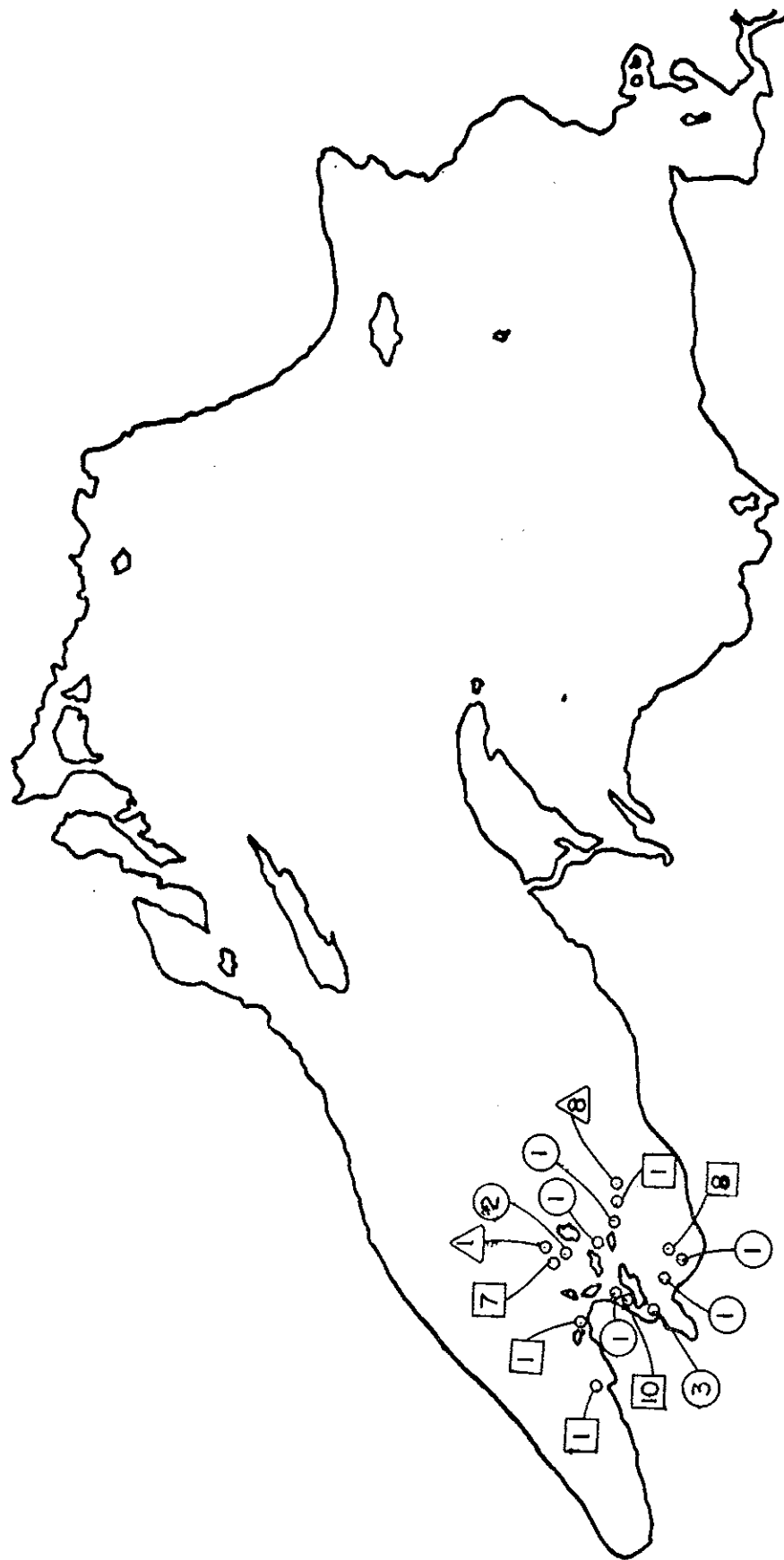
HATCHERY ORIGIN LAKE TROUT TAG RETURNS



AUGUST - SEPTEMBER

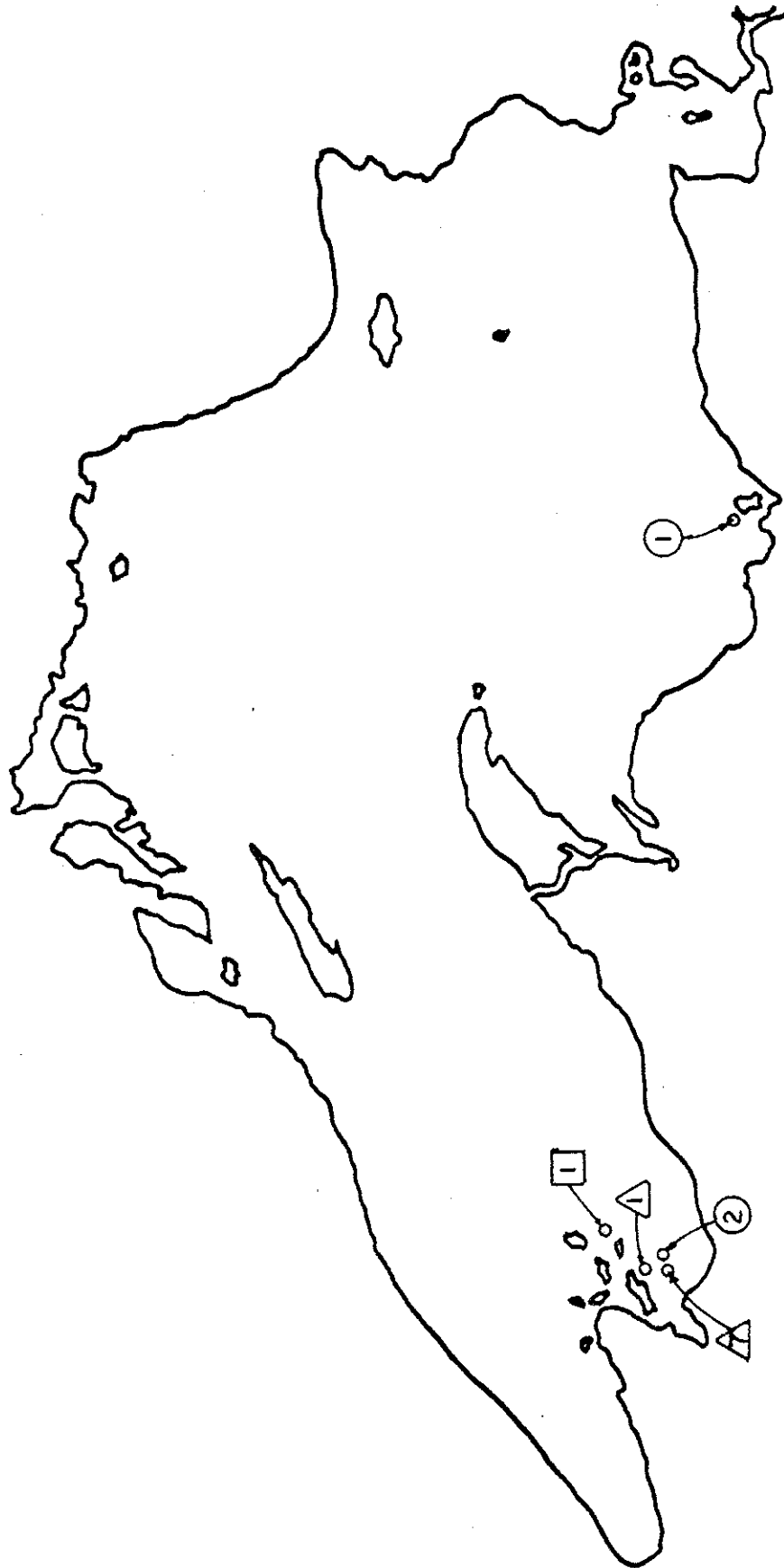
Appendix XI

HATCHERY ORIGIN LAKE TROUT TAG RETURNS



OCTOBER

HATCHERY ORIGIN LAKE TROUT TAG RETURNS



NOVEMBER - DECEMBER

Dist.: Fish Mgrs.
Fish Mgt. Staff
List 2

